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THE SIGNIFICANCE OF WELDING AND JOINING TECHNOLOGY IN A MODERN INDUSTRIAL STRUCTURE

In this article describes the significance of welding and joining technology in the modern industrial world. Economic significance, standardization and quality assurance in welding technology was discussed.

Key words: *welding and joining technology, application, economic significance, quality assurance, standardization.*

Today, the industrial production of technical goods, particularly of investment goods, is hardly conceivable without joining technology. Welding, brazing and adhesive bonding are used for the manufacture of household appliances, vehicles of all kinds and electrical and electronic devices as well as for building structures in the private and industrial sectors. Today, joining technology accounts for a substantial proportion of the entire manufacturing process of investment goods. Examples are specified on Table 1.

Variety of welding processes is shown in Table 2 [1].

All these welding processes manufacture joints whose metallurgical properties at the joining point are identical or very similar to those in the base materials to be joined. This results in advantages over other joining processes, e. g. strength and corrosion properties in the welded joint which are identical or very similar to those in the base material, thus permitting weight-saving joints without any overlapping of the ends of the components. It is disadvantageous that, as a rule, the high heat input alters the properties of the base materials in the weld region and, during the cooling, leads to the build-up of residual stresses and the formation of distortion.

Table 1

Proportion of the value added by welding in some sectors as examples

Sector	Value added by welding, %
Construction of metal and plastic pipelines	approx. 3
Metal construction	approx. 5
Vehicle construction (motor and rail vehicles)	approx. 7
Shipbuilding	approx. 8
Aerospace construction: (including allied joining technologies)	approx. 8

according to internal calculations by DVS / GSI in 2012

Table 2

Pressure welding and fusion welding processes according to the German industrial standard DIN 8563-6 [1]

Pressure welding	using a solid
	using a liquid
	using a gas
	using an electric gas discharge
	using radiation
	using the movement of mass
	using electric current
Fusion welding	using a liquid
	using a gas
	using an electric gas discharge
	using radiation
	using electric current

In principle, almost all processes are applied in all the sectors of the investment goods industry and of the skilled trades processing metals or plastics. To an absolutely crucial extent, the choice of the suitable welding process depends not only on the materials to be joined and the economic viability but also on the experience of the user. While manual joining processes are primarily utilised in single-item fabrication

(such as manual metal arc welding), mechanised or automated processes are applied in series fabrication, frequently with robot support, e. g. spot welding in automobile manufacture, metal arc welding in metal construction and plant engineering, beam welding for the manufacture of precision parts or friction stir welding in aluminum processing.

In its publication entitled "Improving Global Quality of Life through Optimum Use and Innovation of Welding and Joining Technologies", the International Institute of Welding (IIW) provided a detailed description of the state of the art of joining in the most important industrial sectors and an outlook into the future [2].

With regard to the manufacture of investment goods in particular, welding technology and joining technology have not only technical significance but also outstanding economic significance. This is illustrated by an analysis which has been made on behalf of DVS – German Welding Society and has been updated for many years [3].

Another interesting factor relates to the consideration of the worldwide trade in devices and facilities for welding, cutting and surfacing which may be assessed to be over US Dollar 7 billion (Table 3) and of the scope of the Russian imports of products in this field which had a scope of US Dollar 963 million in 2012 (Table 4).

Table 3

World markets for products related to machinery, plants and applications for welding, cutting and surfacing (2012), key regions

Total input from the world into	US Dollar million
China	3,468
Russian Federation	963
India	699
Brazil	619

Joining technology has considerable significance from a different viewpoint as well. The reliability and safety of a lot of technical products is dependent on the reliability of the welds and the joints. The failure of a single weld may lead to the

bursting of a pressure vessel or a pipeline, to the collapse of a bridge or a crane, or to a car accident.

It is a very complicated process to test the quality of material-locking joints in particular without destroying them, if this is possible at all. Therefore, outstanding significance is attached to the competence of the manufacturers and operators of welded and joined products in joining and welding technology. This encompasses not only the manufacture of welded, brazed or adhesive-bonded parts but also the planning, designing, engineering and operation of them (Fig. 1). This necessitates the qualified training of the personnel responsible in each case.

Table 4

Supply markets for products imported into the Russian Federation
«Top Five»

Products related to machinery, plants and applications for welding, cutting and surfacing (2012)		
Total input from	US Dollar million	%
Germany	172	18
China	171	18
Italy	101	10
USA	57	6
Rep. Korea	26	3

Essential support with regard to the selection of the process suitable in each case and of the suitable quality assurance is provided by the national and international standardisation. If manufacturers and operators comply with this, they are also protected from rights of recourse to a great extent.

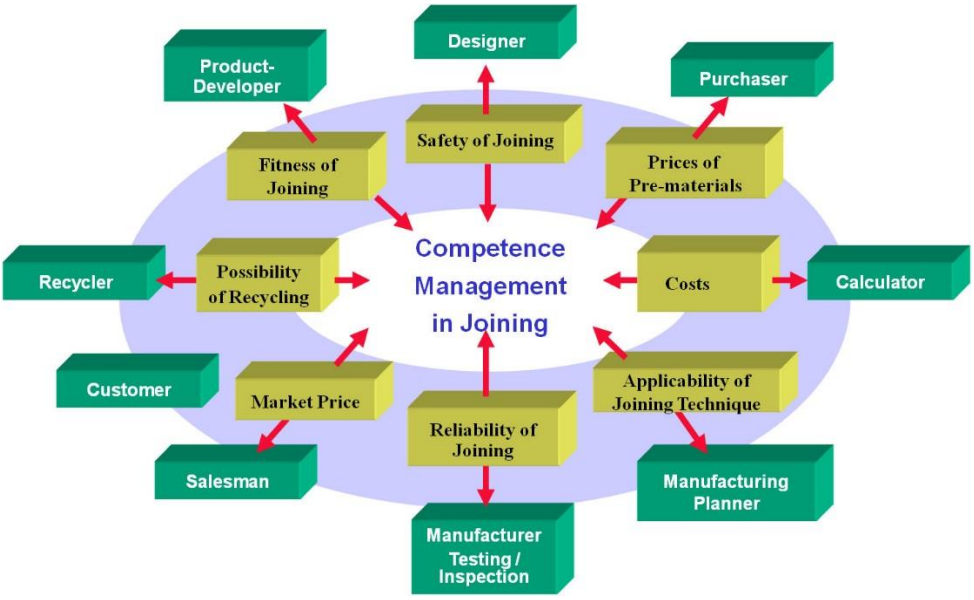

Fig. 1. Competence management in joining technology

Plants which manufacture investment goods and process metals or plastics attach outstanding significance to the standardisation in joining technology and particularly in welding technology. The experience and research results from all sectors are incorporated into this standardisation which allows the know-how to be passed on to the next generation across different sectors. Product standards supply additional information about product-specific details or peculiarities.

Essential standardisation fields of welding technology and examples of international standards are portrayed on Fig. 2.

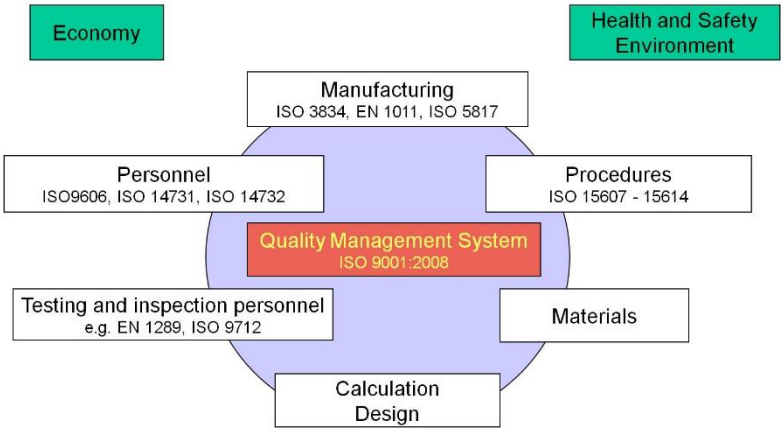

Fig. 2. Essential standardisation fields for quality assurance during welding and examples

Megatrends which influence joining technologies the most are globalisation, demographic change, individualism and sustainability [4]. The requirements on joining technology will also alter due to these megatrends and with advancing technology and changing resources of energies and raw materials. Multimaterial design will be applied right down to single components, depending on the individual needs of the ultimate consumers and on the stressing, availability (prices) and reusability of the compatible materials. The surfacing of components for corrosion or wear protection is already customary today. The composite construction method with aluminium and steel is being utilised in the automobile industry to an increasing extent. Glass as a load-bearing element is conceivable even in the construction of buildings. The objective is to use fibre-reinforced plastics in the material-locking joint with metals. The various joining processes will stay in continuous competition for application. Joining is knowledge-based. Joining processes are increasingly based on and driven by knowledge and science [4]. In this respect, interdisciplinary links are just as indispensable as the corresponding training and further education of the specialist personnel at universities and in the plants.

Literature

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